WIDE-BAND CALIBRATED PREAMP TYPE A INSTRUCTION MANUAL

TEKTRONIX, INC.
MANUFACTURERS OF CATHODE-RAY AND VIDEO TEST INSTRUMENTS

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TYPE A SERIAL NUMBER 3196

TYPE A
PLUG-IN UNIT
SERIAL
WIDE-BAND
CALIBRATED PREAMP
.05-20 V/CM DC COUPLED
PREAMP RISETIME = .015 μSEC
VERTICAL
POSITION
INPUT A
DC BAL.
1 MEG. 47 μμF
INPUT
SELECTOR
DC
AC
AC
DC
VARIABLE
VOLTS/CM
2
1
.5
.2
.1
5
10
20
CALIBRATED
INPUT B
GAIN ADJ.
1 MEG. 47 μμF
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.

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GENERAL DESCRIPTION

GENERAL

The Type A Plug-In Unit is a wide-band, calibrated preamp, designed for use with Tektronix Type 530-, 540-, and 550-series Oscilloscopes. The unit combines dc coupling and excellent transient response with calibrated sensitivities and dual inputs to provide good versatility for general-purpose oscilloscope usage.

A SPECIFICATIONS

Transient Response

Preamp Alone
Risetime—.015 microseconds.
With Type 541 and Type 545
Risetime — .018 microseconds.
With Type 531 and Type 535
Risetime — .035 microseconds.
With Type 532
Risetime — .07 microseconds..

Frequency Response

With Type 541 and Type 545
Passband—DC to 20 mc, 2 cps to 20 mc ac.
With Type 531 and Type 535
Passband—DC to 10 mc, 2 cps to 10 mc ac.
With Type 532
Passband—DC to 5 mc, 2 cps to 5 mc ac.
(Down not more than 3 db at above limits.)

Deflection Factor—.05 v/cm ac or dc.

Signal Inputs—Two signal inputs with more than 60 db isolation.

Step Attenuator

Nine positions, calibrated, from .05 v/cm to 20 v/cm, accurate within 3% when set on any one step.

Maximum Allowable Combined DC and Peak AC Input Voltage—600 v.

Input Impedance—1 megohm, 47 $\mu\mu$f.
With P410 probe—10 megohms, 11 $\mu\mu$f.
With P510 probe—10 megohms, 14 $\mu\mu$f.

Mechanical Specifications

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight—3½ lbs.

FUNCTIONS OF CONTROLS AND CONNECTORS

INPUT A **INPUT B**	Separate UHF coax connectors to the preamp by way of the **INPUT SELECTOR** switch.
INPUT SELECTOR	Four-position switch to select either of the two inputs and the type of input coupling.
DC BAL	Screwdriver control to adjust the amplifier balance so the trace does not shift as the **VARIABLE** control is rotated.
VERTICAL POSITION	Control to position the trace vertically.
GAIN ADJ.	Screwdriver control to set the basic gain of the preamp.
VOLTS/CM	Nine-position switch to select the calibrated vertical-deflection sensitivities.
VARIABLE	Control to vary the gain over a range of about 2½ to 1.

OPERATING INSTRUCTIONS

General

The Type A, 540-Series or 550 Series Plug-In Unit is designed to operate as a preamplifier for a Tektronix 530-Series, 540-Series or 550-Series Oscilloscope. We assume that it will be operated in that manner in the following instructions.

Input Connections

Be careful when you make connections to the preamp **INPUT** connectors that the external circuitry does not cause deterioration of the waveform. Improper termination of cables may cause ringing or loss of frequency response. If you use unshielded leads keep them short as possible to minimize hum. Leads which pass near the cathode-ray-tube screen may pick up some ripple from the high-voltage power supply. If this occurs try relocating the leads or use additional shielding.

Two cables can be connected to the preamp at once. You can then select the signal on either cable with the **INPUT SELECTOR** switch. However, if one signal is very much larger than the other, some crosstalk may occur and the cable having the strong signal should be disconnected.

Probe

The Type P410 probe, furnished with the 540-Series Oscilloscopes, is designed to preserve the transient response of this unit. This probe introduces no ringing but causes an additional frequency-response loss of less than 1 db at 20 mc. The Type P410 probe has a 10-to-1 attenuation ratio.

The Type P510 probe is not suitable for use with the Type A Plug-In Unit and 540-Series combination when you are looking at fast-rising pulses. This probe tends to ring at about 50 megacycles, and the wide passband of the A 540-Series combination will display any ringing which may occur.

Be sure to check the adjustment of the probe when you first connect it to a plug-in unit. The probe compensation is a function of the input capacitance of the particular plug-in unit or oscilloscope that you use the probe with. If the compensation is incorrect, the frequency response will be affected.

Touch the probe tip to the calibrator output connector and display several cycles of the calibrator waveform. If the top and bottom of the displayed square wave are not flat, adjust the trimmer capacitor located either inside the probe body or inside the box at the other end of the cable to achieve correct square-wave response.

Coupling

It is sometimes unnecessary or undesirable to display the dc level of the waveform. In the two **AC** positions of the **INPUT SELECTOR** switch, a capacitor in series with the input blocks the dc component of the waveform so that only the ac component is displayed.

Deflection Sensitivity

The **VOLTS/CM** switch inserts frequency-compensated attenuators ahead of the amplifier. The **VARIABLE** control provides continuous adjustment of the deflection sensitivity between the values indicated by the **VOLTS/CM** switch.

> Note: The **VARIABLE** control must be clockwise to the **CALIBRATED** position for the sensitivity to be as indicated by the **VOLTS/CM** control.

Gain Adjustment

Ageing of tubes will affect the gain of the plug-in unit. After the plug-in unit has been in use for a period of time the gain adjustment should be checked. Display a calibrator waveform of 0.2 volts peak to peak with the **VOLTS/CM** switch in the **.05** position. Adjust the **GAIN ADJ.** control until the displayed waveform is four graticule divisions in amplitude. Be sure the **VARIABLE** control is turned clockwise to the **CALIBRATED** position before making this adjustment.

DC Balance Adjustment

The need for adjustment of the **DC BAL.** control is indicated by a shift in the position of the trace as the **VARIABLE** control is rotated. This is caused by tube ageing and the resultant shift in operating potentials. This adjustment should be made after the **GAIN ADJ.** control is set. Rotate the **VARIABLE** control back and forth and adjust the **DC BAL.** control until the trace position is no longer affected by rotation of the **VARIABLE** control.

Positioning Adjustment

The VERT POS RANGE control balances the dc output level so the full range of the front-panel positioning control can be utilized. The VERT POS RANGE control is located at the left to the rear of the plug-in unit and is accessible when the left side panel is removed. Center the **VERTICAL POSITION** control. Adjust the VERT POS RANGE control to center the trace on the screen.

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CIRCUIT DESCRIPTION

General

The Type A Plug-In Unit has a maximum sensitivity of .05 volts per centimeter dc. The circuit consists of one stage of amplification preceded and followed by cathode followers.

Input Connectors

There are two input connectors which can be switched into the input circuits by SW3021, the **INPUT SELECTOR** switch. This switch is wired physically so as to reduce coupling between inputs to a minimum. Blocking capacitor C3041 is shorted out in the DC positions of the selector switch.

Input Attenuators

The **VOLTS/CM** switch inserts frequency-compensated attenuators into the input circuit. Four attenuators are used singly or in tandem pairs to produce nine sensitivities. The X1 attenuation network compensates for lead inductance in the input circuits.

DC Balance

The **DC BAL** control, R4401, provides an adjustable dc grid voltage for V3551 so that its cathode is at the same dc potential as the cathode of V3401. When this control is properly set, no change in vertical positioning will result when the **VARIABLE** control is rotated.

Input Cathode Follower

The input cathode follower, V3251, isolates the input circuits from changes in capacitance as the **VARIABLE** control is rotated. R3281 is a current-limiting resistor to limit the grid current in the event an excess voltage is applied to the input.

Amplifier

The amplifier stage, V3401 and V3551, is a common-cathode phase-splitter amplifier. Coils L3401 and L3581 form peaking networks in the plate circuits. R3401 provides the current for the amplifier plates, and a tap to the heater string provides a low impedance at this point.

The **VARIABLE VOLTS/CM** control, R3511, varies the gain over a 2½-to-1 ratio by varying the degeneration in the cathode circuit. R3541, labeled **GAIN ADJ.** varies the current in this stage to set the gain to agree with the front-panel calibration.

Vertical positioning is produced by two dual potentiometers connected to the plates of the amplifier so that current through one plate load is increased as current through the other plate load is decreased. Since the amplifier is dc coupled beyond this point, the change in plate voltage which occurs changes the position of the trace on the cathode ray tube.

Output Cathode Followers

Output cathode followers are used to drive the capacitance of the interconnecting plug and main-amplifier input circuit. The cathode follower circuit is modified by resistors in the plate circuits and by capacitors cross-connected from the plates to the opposite cathodes. This modification improves the high-frequency balance of the preamp.

The HF PEAKING control, R3871, varies the current in the cathode followers. This changes the impedance at the cathodes and changes the effect of the series peaking coils, L3841 and L3941, tied to these cathodes.

PARTS ORDERING AND REPLACEMENT

Instruction Manual

A Tektronix instruction manual usually contains hand-made changes to diagrams and parts lists, and sometimes text. These changes are in general appropriate only to the instrument the manual was prepared for. These hand-made corrections shows changes to the instrument that have been made after the printing of the manual.

There is a serial number on the frontispiece and on the warranty page of this manual. This is the serial number of your instrument. Be sure the manual number matches the instrument number when you order parts.

NOTE

Always include the instrument type AND SERIAL NUMBER in any correspondence regarding the instrument.

Standard Components

Tektronix will supply replacement components at current net prices. However, since most of the components are standard electronic and radio parts you can probably obtain them locally faster than we can ship them to you from the factory in Portland, Oregon. Be sure to consult the instruction manual to see what tolerances are required.

Selected Components

We specially select some of the components, whose values must fall within prescribed limits, by sorting through our regular stocks. The components so selected will have standard RETMA color coding showing the value and tolerance of the stock they were selected from, but they will not in general be replaceable from dealer's stocks.

Checked Tubes

To obtain maximum reliability and performance we check some of the vacuum tubes in our instruments for such characteristics as microphonics, balance, transconductance, etc. We age other tubes to stabilize their characteristics. Since there are no well defined standards of tube performance we have established our own arbitrary standards and have developed equipment to do this checking. These checked tubes can be purchased through our local Field Engineering Offices or directly from the factory in Portland, Oregon.

Tektronix Manufactured Parts

Tektronix manufactures almost all of the mechanical parts and some of the components used in the instrument. If you order a mechanical part be sure to describe the part completely to prevent any unnecessary delay in filling your order. When you have any questions about mechanical parts or Tektronix manufactured components contact our nearest Field Engineering Office or write to the Field Engineering Department at the factory in Portland, Oregon.

GENERAL INFORMATION

Color Coding

We use color-coded wires in the instruments to help identify the various circuits. These wires will be either a solid color or will be a solid color (including black and white) with one or more colored stripes. The colored stripes are "read" in the same manner as the RETMA resistor color code. In the case of multiple stripes the wide stripe is read first.

Wires carrying positive regulated-power-supply voltages are white and the stripes indicate the supply voltage. For example, the +225-v supply bus will be coded red-red-brown (2-2-1) giving two significant figures and the decimal multiplier.

The negative-supply bus wires are black and the stripes indicate the supply voltage. For example, our most common negative-supply voltage is —150 v and is carried by a black wire coded brown-green-brown (5-1-5).

The mains-voltage leads to the power transformer are yellow and coded brown-brown-brown (1-1-1).

The tube heater leads are white and coded 6-1, 6-2, 6-3, etc., not to indicate that the voltages are different but to differentiate between circuits.

In other respects the color coding will vary from instrument to instrument. In general all signal-carrying leads are white and coded with a single colored stripe. In a few places where the number of leads exceed the capabilities of single-stripe coding we have used solid-color leads.

Soldering Precaution

The solder used on the ceramic terminals of this instrument must contain a small percentage of silver. Repeated use of ordinary tin-lead solder will dissolve the fused bond of silver that makes the solder adhere to the porcelain, especially if the soldering iron is quite hot.

A quantity of the silver-bearing solder that we use at the factory is attached to each major instrument having ceramic strips. This solder, containing approximately 3% silver, is not readily available through regular channels. If you need additional silver-bearing solder for maintenance purposes you can purchase it from Tektronix in one-pound spools.

TROUBLE-SHOOTING PROCEDURE

Trouble shooting of plug-in units is somewhat complicated by the need to determine whether the trouble observed is in the plug-in unit or in the oscilloscope. Many troubles can be quickly isolated by substituting another plug-in unit and looking for the same indications. Among the troubles which fall into this category are insufficient gain, inability to position the trace, noise, unbalance and severe waveform distortion. Minor waveform distortions such as might be caused by high-frequency peaking coils or delay-line trimmers can be isolated by this method only by substituting another plug-in unit of equal or superior bandwidth and checking for the same distortion.

Noise and unbalance problems can also be isolated by connecting a jumper from pin 1 to pin 3 of the interconnecting plug. If the trouble remains, it is probably not in the plug-in unit.

Most troubles are caused by tube failures and you can frequently find them by finding the bad tube and replacing it with a good one. It is a good practice to inspect components in the circuit with the bad tube for possible overheating as a result of the tube failure. One way to find bad tubes is to try replacing suspected tubes with good ones.

ADJUSTMENT PROCEDURE

The following outline is based on the adjustment procedure used in our test department at the factory. Ordinarily, adjustment in the field will consist of touching up some of the dc level and balance controls as outlined in the OPERATING INSTRUCTIONS, but if readjustment of the transient response is necessary there is a certain sequence that should be followed.

Peaking Coils

The unit must be plugged into an oscilloscope that is known to be in correct adjustment. A source of square waves or pulses of 5 mμsec rise time or better is required for optimum adjustment although the Tektronix Type 105 Square-Wave Generator will permit adjustment to within about ½% of optimum. The oscilloscope calibrator waveform is not adequate. If you use a Type 105 Square-Wave Generator, use a 52-ohm cable terminated at both ends to achieve the fastest rise time possible.

All adjustments are available when the unit is plugged into an oscilloscope that has its panels removed.

If this unit is used in 530-Series Oscilloscopes only, the peaking coils should not be adjusted. The effect of these peaking coils can only be seen when the unit is used in 540-Series Oscilloscopes. If it is used with 540-Series Oscilloscopes the following procedure applies.

Plug the unit into a 540-Series Oscilloscope and turn the power on. Turn the **VOLTS/CM** switch to .05, and the **VARIABLE** control clockwise to the **CALIBRATED** position. Connect the square-wave source to **INPUT A** and display one or two cycles of a 250- to 500-kc square wave with two to three centimeters of deflection.

The peaking coils affect the rise and leading corner of the square wave and should be adjusted for a square corner with no overshoot. Preset the HF PEAKING control counterclockwise. Adjust L3401 and L3581.

The HF PEAKING control affects the leading edge only. Adjust this control to get a sharp corner on the waveform.

Input Attenuators

The need for adjustment of the input attenuators is determined by observing the response to a 1-kc square wave. There are two types of adjustment to be made. One is to compensate the attenuators so the ac attenuation is equal to the dc attenuation. This involves a moderately short time constant and can be recognized as a slight rounding or overshoot at the leading corner of a 1-kc square wave. The other type of adjustment is to set the input capacitance equal in all positions of the attenuator. Misadjustment can be recognized as a downward or upward slope of about the first one-half of the 1-kc square wave.

The input capacitance of the unit is accurately set to 47 $\mu\mu$f here at the factory. This permits a properly adjusted probe to be used with any 47-$\mu\mu$f-input-capacitance unit. To preserve this feature you will need to use a CS-47 Input-Capacitance Standardizer or standardize a probe by adjusting it to a unit known to be in adjustment. Another method of obtaining the standard input capacitance is to use a Tektronix Type 130 L,C Meter to set the input capacitance in the .05 position of the **VOLTS/CM** switch. Then adjust the probe in this position to standardize the probe. This probe can then be used where the text calls for the Input-Capacitance Standardizer.

For best results, the attenuator adjustments should be made with a square-wave generator

having a short rise time, such as the Tektronix Type 105. An approximate adjustment can be made by using the calibrator waveform, but it is easy to overcompensate the attenuator when using this waveform because of its long risetime.

1. Input-Capacitance Adjustment

The input capacitance of the preamp in the unattenuated position is adjusted first.

a. Connect the Input-Capacitance Standardizer (or standardized probe) to **INPUT A.**

b. Set the **VOLTS/CM** switch to **.05.**

c. Connect the output of the square-wave generator to the Standardizer.

d. Set the square-wave generator to 1-kc and view five or six cycles on the screen.

e. If necessary, adjust C3261 for a flat top on the square wave.

2. Attenuator Compensation

The attenuator is compensated to make the ac attenuation equal to the dc attenuation.

a. Remove the Standardizer and connect the square-wave generator to **INPUT A.**

b. Set the **VOLTS/CM** switch in the positions indicated and adjust each capacitor in the following table for a square corner on the square wave.

VOLTS/CM	CAPACITOR
.1	C3231
.2	C3171
.5	C3111
5	C3071

3. Attenuator Input Capacitance

The input capacitance of the attenuators is adjusted to match the Input Capacitance Standardizer in all positions.

a. Reconnect the Standardizer to **INPUT A.**

b. Connect the output of the square-wave generator to the Standardizer.

c. Adjust the capacitors listed in the following table for a flat top on the square wave.

VOLTS/CM	CAPACITOR
.1	C3221
.2	C3161
.5	C3101
5	C3061

If an Input-Capacitance Standardizer was used in the preceeding procedure the probes supplied with the instrument should now be adjusted as follows.

a. Remove the Standardizer.

b. Connect the probe to **INPUT A.**

c. Adjust the trimmer in the probe body until the top of the square wave is flat.

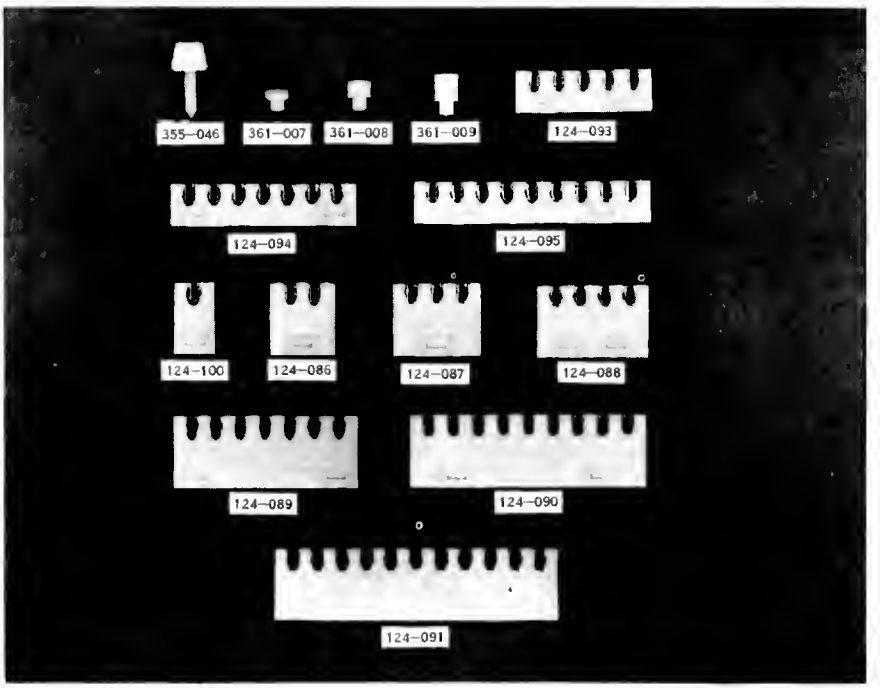
MODIFICATION NOTICE

CLIP-MOUNTED CERAMIC STRIPS

YOUR INSTRUMENT MAY BE EQUIPPED WITH CLIP-MOUNTED CERAMIC STRIPS. IF YOU FIND IT NECESSARY TO ORDER THESE STRIPS FOR REPLACEMENT, BE SURE TO CONSULT THIS SHEET. INCLUDE A DESCRIPTION OF THE PART, PART NUMBER, INSTRUMENT TYPE AND SERIAL NUMBER.

CERAMIC STRIP PARTS LIST

	PART NUMBER
STUD, CLIP, MOLDED NYLON	355-046
SPACER, MOLDED NYLON, 5/32" HEIGHT	361-007
SPACER, MOLDED NYLON, 1/4" HEIGHT	361-008
SPACER, MOLDED NYLON, 3/8" HEIGHT	361-009
CERAMIC STRIP, 7/16" BY 3 NOTCHES	124-092
CERAMIC STRIP, 7/16" BY 5 NOTCHES	124-093
CERAMIC STRIP, 7/16" BY 7 NOTCHES	124-094
CERAMIC STRIP, 7/16" BY 9 NOTCHES	124-095
CERAMIC STRIP, 7/16" BY 11 NOTCHES	124-106
CERAMIC STRIP, 3/4" BY 1 NOTCH	124-100
CERAMIC STRIP, 3/4" BY 2 NOTCHES	124-086
CERAMIC STRIP, 3/4" BY 3 NOTCHES	124-087
CERAMIC STRIP, 3/4" BY 4 NOTCHES	124-088
CERAMIC STRIP, 3/4" BY 7 NOTCHES	124-089
CERAMIC STRIP, 3/4" BY 9 NOTCHES	124-090
CERAMIC STRIP, 3/4" BY 11 NOTCHES	124-091



CERAMIC STRIPS AND MOUNTINGS USED IN TEKTRONIX EQUIPMENT.

ABBREVIATIONS

Cer.	ceramic	m	milli or 10^{-3}
Comp.	composition	Ω	ohm
EMC	electrolytic, metal cased	Poly.	polystyrene
EMT	electrolytic, metal tubular	Prec.	precision
f	farad	PT	paper tubular
h	henry	Tub.	tubular
k	kilohm or 10^3 ohms	v	working volts dc
meg	megohm or 10^6 ohms	Var.	variable
μ	micro or 10^{-6}	w	watt
μμ	micromicro or 10^{-12}	WW	wire wound

GMV guaranteed minimum value

WIDE-BAND CALIBRATED PREAMP

Capacitors

						Order Parts by Number
C3041	.1 μf	PT	Fixed	600 v	20%	285528
C3051	12 μμf	Cer.	Fixed	500 v	10%	281505
C3061	4.5–25 μμf	Cer.	Var.	500 v		281010
C3071	1.5–7 μμf	Cer.	Var.	500 v		281005
C3081	250 μμf	Mica	Fixed	500 v	5%	283543
C3101	4.5–25 μμf	Cer.	Var.	500 v		281010
C3111	4.5–25 μμf	Cer.	Var.	500 v		281010
C3121	150 μμf	Mica	Fixed	500 v	10%	283544
C3161	4.5–25 μμf	Cer.	Var.	500 v		281010
C3171	3–12 μμf	Cer.	Var.	500 v		281007
C3211	4.7 μμf	Cer.	Fixed	500 v	±1 μμf	281501
C3221	3–12 μμf	Cer.	Var.	500 v		281007
C3231	4.5–25 μμf	Cer.	Var.	500 v		281010
C3251	270 μμf	Cer.	Fixed	500 v	20%	281543
C3261	3–12 μμf	Cer.	Var.	500 v		281007
C3281	.005 μf	Cer.	Fixed	500 v	GMV	283001
C3321	.005 μf	Cer.	Fixed	500 v	GMV	283001
C3841	.005 μf	Cer.	Fixed	500 v	GMV	283001
C3941	.005 μf	Cer.	Fixed	500 v	GMV	283001
C4401	.001 μf	Cer.	Fixed	500 v	GMV	283000
C4451	.005 μf	Cer.	Fixed	500 v	GMV	283001
C4511	.01 μf	Cer.	Fixed	500 v	GMV	283002
C4521	.047 μf	PT	Fixed	400 v	20%	285519
C4531	.01 μf	Cer.	Fixed	500 v	GMV	283002

Inductors

				Order Parts by Number
L3401	3.3–6 μh	Var.		114053
L3431	.3 μh	Fixed		108112
L3581	3.3–6 μh	Var.		114053
L3841	.3 μh	Fixed		108112
L3941	.3 μh	Fixed		108112

Resistors

						Order Parts by Number
R3001	27 Ω	½ w	Fixed	Comp.	10%	302270
R3011	27 Ω	½ w	Fixed	Comp.	10%	302270
R3041	47 Ω	½ w	Fixed	Comp.	10%	302470
R3071	990 k	½ w	Fixed	Prec.	1%	309013
R3081	10.1 k	½ w	Fixed	Prec.	1%	309034
R3111	900 k	½ w	Fixed	Prec.	1%	309111
R3121	111 k	½ w	Fixed	Prec.	1%	309046
R3141	27 Ω	½ w	Fixed	Comp.	10%	302270
R3171	750 k	½ w	Fixed	Prec.	1%	309010
R3181	333 k	½ w	Fixed	Prec.	1%	309053

Resistors (Continued)

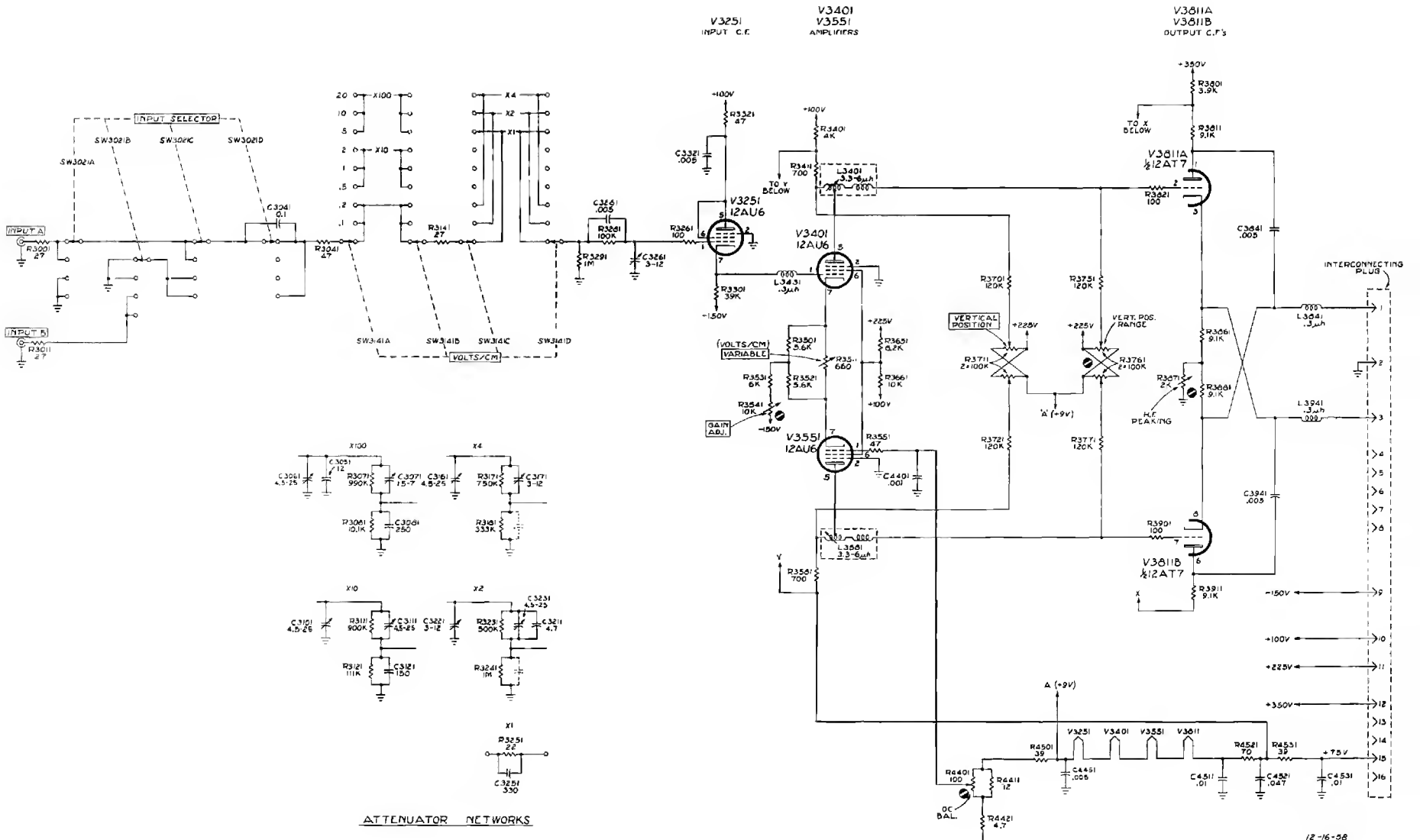
R3231	500 k	½ w	Fixed	Prec.	1%		309003
R3241	1 meg	½ w	Fixed	Prec.	1%		309014
R3251	22 Ω	½ w	Fixed	Comp.	10%		302220
R3261	100 Ω	½ w	Fixed	Comp.	10%		302101
R3281	100 k	½ w	Fixed	Comp.	10%		302104
R3291	1 meg	½ w	Fixed	Prec.	1%		309014
R3301	39 k	1 w	Fixed	Comp.	10%		304393
R3321	47 Ω	½ w	Fixed	Comp.	10%		302470
R3401	4 k	5 w	Fixed	WW	5%		308051
R3411	700 Ω	½ w	Fixed	Prec.	1%		309083
R3501	5.6 k	1 w	Fixed	Comp.	5%		303562
R3511	660 Ω	Special				VARIABLE	311118
R3521	5.6 k	1 w	Fixed	Comp.	5%		303562
R3531	6 k	5 w	Fixed	WW	5%		308052
R3541	10 k	2 w	Var.	WW	20%	GAIN ADJ.	311015
R3551	47 Ω	½ w	Fixed	Comp.	10%		302470
R3581	700 Ω	½ w	Fixed	Prec.	1%		309083
R3651	8.2 k	1 w	Fixed	Comp.	10%		304822
R3661	10 k	½ w	Fixed	Comp.	10%		302103
R3701	120 k	½ w	Fixed	Comp.	10%		302124
R3711	2x100 k	2 w	Var.	Comp.	20%	VERTICAL POSITION	311028
R3721	120 k	½ w	Fixed	Comp.	10%		302124
R3751	120 k	½ w	Fixed	Comp.	10%		302124
R3761	2x100 k	2 w	Var.	Comp.	20%	Vert. Pos. Range	311051
R3771	120 k	½ w	Fixed	Comp.	10%		302124
R3801	3.9 k	2 w	Fixed	Comp.	10%		306392
R3811	9.1 k	1 w	Fixed	Comp.	5%		303912
R3821	100 Ω	½ w	Fixed	Comp.	10%		302101
R3861	9.1 k	1 w	Fixed	Comp.	5%		303912
R3871	2 k	2 w	Var.	Comp.	20%	H.F. Peaking	311008
R3881	9.1 k	1 w	Fixed	Comp.	5%		303912
R3901	100 Ω	½ w	Fixed	Comp.	10%		302101
R3911	9.1 k	1 w	Fixed	Comp.	5%		303912
R4401	100 Ω	2 w	Var.	Comp.	20%	DC BAL	311003
R4411	12 Ω	1 w	Fixed	Comp.	10%		304120
R4421	4.7 Ω	1 w	Fixed	Comp.	10%		307009
R4501	39 Ω	2 w	Fixed	Comp.	10%		306390
R4521	70 Ω	5 w	Fixed	WW	5%		308078
R4531	39 Ω	2 w	Fixed	Comp.	10%		306390

Switches

					not wired	wired
SW3021	2 wafer	4 position	rotary	INPUT SELECTOR	260081	—
SW3141	5 wafer	9 position	rotary	VOLTS/CM	260158	262111

Vacuum Tubes

V3251	12AU6	Input Cathode Follower	154040
V3401	12AU6	Amplifier	154040
V3551	12AU6	Amplifier	154040
V3811	12AT7	Output Cathode Follower	154039



ATTENUATOR NETWORKS

D

TYPE A PREAMP

ABBREVIATIONS USED IN OUR PARTS LISTS

Cer.	ceramic	m	milli
Comp.	composition	Ω	ohm
EMC	electrolytic, metal cased	Poly.	polystyrene
EMT	electrolytic, metal tubular	Prec.	precision
f	farad	PT	paper tubular
h	henry	Tub.	tubular
k	thousands of ohms	v	warking volts dc
meg	megohms	Var.	variable
μ	micro	w	watt
$\mu\mu$	micromicro	WW	wire wound
	GMV guaranteed minimum value		

ABBREVIATIONS USED IN OUR CIRCUIT DIAGRAMS

Resistance values are in ohms. The symbol k stands for thousands. A resistor marked 2.7 k has a resistance of 2,700 ohms. The symbol M stands for million. For example, a resistor marked 5.6 M has a resistance of 5.6 megohms.

Unless otherwise specified on the circuit diagram, capacitance values marked with the number 1 and numbers greater than 1 are in $\mu\mu$f. For example, a capacitor marked 3.3 would have a capacitance of 3.3 micromicrofarads. Capacitance values marked with a number less than 1 are in μf. For example, a capacitor marked .47 would have a capacitance of .47 microfarads.

Inductance values marked in mh are in millihenrys. Inductance values marked in μh are in microhenrys.

Your instrument **WARRANTY** appears on the reverse side of this sheet.

SERIAL NO. 3196

IMPORTANT

Include the INSTRUMENT TYPE and the above SERIAL NUMBER in any correspondence regarding this instrument. The above serial number must match the instrument serial number if parts are to be ordered from the manual. Your help in this will enable us to answer your questions or fill your order with the least delay possible.

WARRANTY

All Tektronix instruments are fully guaranteed against defective materials and workmanship for one year. Should replacement parts be required, whether at no charge under warranty or at established net prices, notify us promptly, including sufficient details to identify the required parts. We will ship them prepaid (via air if requested) as soon as possible, usually within 24 hours.

Tektronix transformers, manufactured in our own plant, carry an indefinite warranty.

All price revision and design modification privileges reserved.